power is acquired. In the vegetable world there has, from the first, been a tendency to form plates, filaments, and later columns of cell aggregates, instead of the blastula form of animal types. Sexuality, or the development of male and female elements, therefore, has a meaning, fraught with consequences and promises which have culminated in the most wonderful morphological and adaptive specialization, and probably in definite ways, which might have been predicted had all the conditions been known.

N. B.—Finally, it is necessary to point out here that these views have little in common with those urged by Geddes. While a preponderance of anabolic activity may produce an ovum, as he supposes, how it is possible to conceive that processes of physiological disintegration or katabolism, such as are witnessed in the breaking down of protoplasm into simpler compounds, could result in the production of male-cells, I utterly fail to comprehend. That growth is accompanied by katabolism there is no doubt, but to assume that the tremendous energy with which karyokinesis manifests itself in spermatogenesis is merely an exhibition of preponderent katabolism, which must result in the enfeeblement of the cells so produced, stands in such obvious contradiction to all that we know of the male-cells, that such an erroneous view must be unhesitatingly pronounced inadequate and unfounded. Anabolism and katabolism, or the molecular processes by which protoplasm is built up and torn down, cannot be tortured into an equivalency with the widely diverse modes of manifestation of karyokinetic activity in the morphologically homologous ovum and sperm mother-cells.

The fundamental error lies in confounding ordinary physiological processes with special modes of the manifestation of karyokinesis, and since there is no other known instance of katabolism resulting in the breaking up of cells by rapid cleavage into small cells, such as those produced from spermoblasts, it may well be doubted if the equivalency sought to be established is anything more than fanciful. —*John A. Ryder.*

PHYSIOLOGY.[1]

GASKELL'S WORK.—The most important recent work on the physiology of peripheral nerves, is that of Dr. W. H. Gaskell, of Cambridge, which has occupied him during the past ten years.[2] Begun as a contribution to cardiac physiology, it has extended itself much beyond this, and bids fair to alter fundamentally our conceptions of the morphological and

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[2] Gaskell's chief articles are published as follows—

Phil. Trans. 1882. p. 993.
Journal of Physiology. Vol. IV. p. 43.
" " Vol. V. p. 362.
" " Vol. VII. p. 1.
Medico-Chirurgical Transactions. Vol. LXXI. (Contains a summary of results up to the receipt of the Marshall Hall Prize.)
Journal of Physiology. Vol. X. p. 153.

physiological natures of peripheral nerves. For this work the author received last year the Marshall Hall prize. An abstract of the results follows.

Gaskell began his work by the study of the innervation of the frog's heart. He found that the vagus not only inhibits but also accelerates the rate of the contractions. This led to the discovery that the vagus in the frog is in reality the vago-sympathetic, *i. e.* the nerve trunk consists in part of vagus fibres, in part of sympathetic fibres, the two uniting early in their course; the vagus fibres proper are inhibitory, the sympathetic fibres cause acceleration. Taking into account not only the primary effects of the stimulation of these fibres, but also the after effects, Gaskell came to the conclusion that "the process of inhibition is bound up with changes in the muscle of a beneficial nature to the further action of that muscle, while the action of the augmentor nerve resembles rather the action of a motor nerve, and causes an exhaustion of the muscular activity." He concluded, therefore, that "inhibition of contraction is the symptom of the action of an *anabolic* nerve *i. e.* a nerve which brings about constructive metabolism, just as much as contraction or augmentation of contraction is the symptom of the action of a *katabolic* nerve *i. e.* a nerve which causes a destructive metabolism." He further studied the nerve supply of the rest of the vascular system, and came to the conclusion that all tissues are supplied with two sets of nerve fibres, one anabolic in nature, the other katabolic.

In the study of the nerves of the tortoise's heart, he found that the sympathetic, or katabolic, fibres were all non-medullated, while the vagus, or anabolic, fibres were medullated. So here was a morphological difference bound up with a physiological difference, and the question arose, does this distinction hold good throughout the entire course

The efferent nerves of the body can be divided into groups according to their function. If this division be not purely artificial, the members of the different groups should agree with one another morphologically as well as physiologically. Gaskell made the following classification of efferent nerves, and studied the different groups with great care.

EFFERENT NERVES:

1. Nerves of the vascular muscles.
   (a) Vaso-motor, *i. e.* vaso-constrictors, accelerators and augmentors of the heart.

(b) Vaso-inhibitory, *i. e.* vaso-dilators and inhibitors of the heart.

2. Nerves of the visceral muscles.
   (a) Viscero-motor.
   (b) Viscero-inhibitory.
3. Glandular nerves.

He found that the "vaso-motor nerves for all parts of the body can be traced as bundles of the finest medullated fibres in the anterior roots of all the spinal nerves between the 10th and 25th, inclusive, along the corresponding *ramus visceralis* (white *ramus communicans*) to the ganglia of the lateral chain (main sympathetic chain) where they become non-medullated and are thence distributed to their destination either directly or after communication with other ganglia." The viscero-motor nerves are also fine medullated fibres which become non-medullated in the chain of sympathetic ganglia. As to the vaso-inhibitory fibres, these too start from the spinal cord as fine medullated fibres, becoming non-medullated in the collateral or terminal ganglia; the difference between the vaso-motor and vaso-inhibitory fibres lies therefore in the place where they lose their medulla, the former becoming non-medullated in the proximal ganglia, the latter in the distal ganglia. The viscero-inhibitory fibres agree with the vaso inhibitory just as the viscero-motor agree with the vaso-motor. The conclusion arrived at from this work is that "the vascular and visceral muscles are throughout supplied by two kinds of nerve fibres of opposite function, the one motor and the other inhibitory; and that further these two kinds of nerve fibres reach the muscle by separate, distinct anatomical paths, the difference of path consisting in a difference of origin from the central nervous system combined with the fact that the inhibitory nerves lose their medulla in more distant ganglia than the corresponding motor nerves." Moreover, the investigation of the course of the efferent nerves led Gaskell to regard the sympathetic and homologous ganglia as the motor or efferent ganglia of these visceral fibres; so that instead of the old conception of two nervous systems which interchange fibres with each other, he would substitute the following definition of the nerve belonging to a spinal segment— "A spinal nerve is composed of anterior and posterior roots both ganglionated, the ganglion of the afferent root always being stationary, while that of the efferent root is vagrant and has traveled away to various distances from the central nervous system,"

these vagrant ganglia being the ganglia of the sympathetic system.

The results of Gaskell's latest work concern the relation between the spinal and cranial nerves. In order to make a comparison between these two, it is necessary to have a clear idea of a complete spinal nerve. According to Gaskell such a nerve consists of— 1. A posterior root composed of afferent fibres, both somatic and splanchnic, the ganglion of which root is stationary in position, and is always situated near the entrance of the fibres into the central nervous system. 2. An anterior root composed of (1) efferent, non-ganglionated, splanchnic and somatic fibres, and (2) efferent, ganglionated, splanchnic fibres, characterized by the fineness of their calibre, the ganglion of which is vagrant and has traveled to a variable distance from the central nervous system. The cranial nerves are then considered seriatim.

The optic and olfactory nerves do not conform to the type of a segmental nerve and are not discussed.

The IIId nerve is efferent in function. It consists of large and small fibres; as it approaches the oculomotor ganglion the large fibres pass off to supply the eye muscles and the small fibres form a separate group and pass into this ganglion, which is therefore considered a typical motor ganglion. The IVth nerve is also efferent in function, and consists of a large fibred and a small fibred portion, but no ganglion cells have been found along its course. As to the afferent fibres of these nerves—both the IIId and IVth possess within themselves degenerated structures which appear to Gaskell to have been originally the nerve cells and nerve fibres corresponding to the cells and fibres of the stationary ganglion on the posterior root of a spinal nerve. These two nerves, then, form the primary segmental nerves of the first and second segments, the function of the degenerated sensory elements being performed by the *ramus ophthalmicus profundus* of the Vth.

The VIth is purely motor; it contains somatic fibres, while the so-called motor part of the Vth contains splanchnic efferent fibres, but no somatic ones; therefore, taking these two nerves together, we have a complete segmental nerve, as far as efferent fibres are concerned. Here, again, we find that the roots of the motor part of the Vth contain within themselves the remains of nerve fibres and ganglia which would correspond to the afferent fibres and posterior ganglion. The *ramus maxillaris superior* of the Vth, which with the *ramus ophthal-*

micus profundus originates in more posterior segments, has replaced the lost sensory elements of the original nerve of the third or mandibular segment.

The VIIth nerve is a splanchnic efferent nerve consisting of both large and small fibres, the small fibres passing into the geniculate ganglion, which would therefore be the ganglion of the anterior root. As to the somatic efferent fibres, Gaskell has not been able as yet to find these. In this nerve, too, the degenerate remains of the sensory fibres and ganglion are found.

The VIIIth nerve is dismissed from consideration, since it is a nerve of special sense, and this might possibly justify its claim to an independent position. Summing up, then, we find that "in the group of motor cranial nerves, formed by the IIId, IVth, VIth and motor part of the Vth, and VIIth nerves, we have at least four fully formed segmental nerves which for some reason or other have lost a certain portion of their original components."

"In the group of nerves which arise from the medulla oblongata we find all the components which make up a fully formed spinal nerve, or rather group of nerves; here, however, there is no sign of any degeneration of any special group of fibres, but rather a dislocation and scattering of the different components, so that the cranial nerves of this group form parts of a number of segmental nerves instead of each one forming a single nerve." Both the IXth and Xth are purely splanchnic nerves. Each possesses two ganglia: the *ganglion jugulare* and *ganglion petrosum* on the one hand, and the *ganglion jugulare* and *ganglion trunci vagi* on the other. Gaskell considers that the two jugular ganglia represent the stationary afferent ganglia of the IXth and Xth nerves, while the *ganglion petrosum glossopharyngei* and the *ganglion trunci vagi* represent the vagrant efferent ganglia. The spinal accessory consists of large and small fibres. The large ones arise in all the roots of the nerve, the small fibres are confined to the medullary and upper cervical roots, and pass into the *ganglion trunci vagi*. All the fibres are splanchic efferent fibres. The hypoglossus is a purely somatic motor nerve. It represents the separated somatic efferent fibres of this region.

The origin of the fibres of the cranial nerves as well as the structure and function of their peripheral nerve fibres, goes to prove the spinal nature of the cranial nerves, for the groups of cells, which give origin to the cranial nerves, are the direct

continuation of the corresponding cell-groups found in the spinal region.

Having homologized the spinal and cranial nerves, Gaskell formulates a theory of the origin of the central nervous system of vertebrates, to explain the degeneration in the anterior groups of cranial nerves. The central nervous system of the vertebrate, considered anatomically and morphologically, suggests two modes of origin which are apparently antagonistic to each other. The segmental arrangement of the nerves and the cells, from which they arise, points to the conclusion that the nervous tissue of the animal, from which the vertebrate arose, was arranged in a distinctly segmental manner. On the other hand the evidence of embryology points to the fact that the formation is tubular. Any theory must then take both these into account. Schwalbe concludes that the evidence points to the origin of the spinal cord from a bilateral chain of ganglia connected together by means of transverse and longitudinal commissures. Gaskell adopts Schwalbe's view, with the addition to this system of another system of higher function, *i. e.*, the cerebrum, cerebellum, etc., connected with the spinal system through the pyramidal tracts, the direct cerebellar tracts and others. This system is not represented in the spinal cord, and does not give rise to any outgoing nerves except nerves of special sense. Beside the nervous structures of the cord, we have the supporting structures; both of these arise from the medullary tube. As to the connection between these two structures, Gaskell holds that both phylogenetically and ontogenetically the evidence points to the fact that "the central nervous system of the higher vertebrate has been formed by the spreading and increase of nervous material over the walls of an originally non-nervous tube, the cellular elements of which tube, whatever may have been its original function, have been utilized as supporting structures or have undergone gelatinous degeneration. Tailwards this tube emerges free from the encasing mass of nervous matter as the neurenteric canal and its walls are continuous with those of the alimentary canal. Headwards this tube passes into the third ventricle and has apparently no anterior opening." The spinal system of vertebrates corresponds to the infra-œsophageal ganglia and ventral chain of invertebrates, while the crura cerebri, peduncles of the cerebellum and other tracts extrinsic to the level of the ventral ganglion chain form the œsophageal collar, the system of higher function corresponding to the supra-

œsophageal ganglia. It follows necessarily that the tube around which the nervous matter has been formed, *i. e.*, the central canal and ventricles, represents part or the whole of the alimentary canal of the vertebrate ancestor. The author believes that he has found in the infundibular region the remains of the terminal œsophageal tube. In the light of this view we have sufficient reason for the degeneration of certain components of the foremost group of nerves, for with the loss of function of the invertebrate alimentary canal, and mouth parts in connection with it, the sensory parts of the nerves supplying that region degenerated.—*Leah Goff.*

ARCHÆOLOGY AND ANTHROPOLOGY.[1]

ANTHRCPOMETRY AS APPLIED TO THE DETERMINATION OF THE ATTRIBUTES OR POWERS OF THE MIND OF MAN.—This is a problem. My only purpose is to consider its feasibility. Its benefits will be apparent. Can it be done?

It will not do, in this age of science, to determine on the entrance to the consideration of a given subject that its discovery or elucidation is impossible because of its extent, distance, mystery, or difficulty. These may be a bar to its discovery, but not to its consideration or attempted discovery.

The scientific discoveries made within the last few years are sufficient answer to this. What question presents greater apparent difficulties—impossibilities that the knowledge that the composition of the flame of the sun or the fixed stars—yet the solar and stellar spectrum has resolved these into their original elements, and we know them as well as we do that of the candle or the coal, which burn before our eyes.

Professor Langley has just informed us that the greater part of the sun's rays are not luminous, and that those which are, are really blue, and not white.

Who could have foreseen that when Galvani, of Bologna, in dissecting a frog (what nonsense, for a great philosopher to fool away his time dissecting frogs!), should have touched with a wire a given nerve, and that the twitch it made in response to his touch should have since then run through a million

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